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ABSTRACT

This report outlines economic components that will eventually contribute to large models of electronic text services in institutions of higher education, and provides a simple and practical assessment of economic issues associated with electronic text for college administrators, faculty, and planners. This assessment constitutes a layman's guide to equipment costs, staffing, production timetables, and cost recovery options for a range of electronic text services. Readers can build a model for services in a particular higher education environment by using the data provided here and reworking them in the context of a specific higher education institution. The report is based on several sources of data, including a survey of electronic text managers in the commercial and nonprofit sections; a survey of college students in three states dealing with their media habits, access to personal computers, and plans to purchase new technologies in the near future; an aggregation of electronic text industry cost and pricing data; and a secondary analysis of survey data collected by other researchers on the uses of new technologies in colleges. (THC)

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Electronic Text Consortium

Electronic Text for Higher Education

San Diego State University, University of Wisconsin, University of Nebraska, WGBH Boston

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AN ECONOMIC ASSESSMENT
OF ELECTRONIC TEXT

Report Number Six
of the
Electronic Text Report Series

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U.S. DEPARTMENT OF EDUCATION
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AN ECONOMIC ASSESSMENT OF ELECTRONIC TEXT

Report Number Six
of the
Electronic Text Report Series

Prepared by

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for the
Electronic Text Consortium

An Annenberg/CPB Project

The mandate of the Annenberg/CPB Project over a 15-year period is to create innovative, quality college-level materials and to demonstrate unique applications of telecommunications technologies in higher education problems.

1984

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PREFACE

This report focuses upon economic issues associated with electronic text. It is intended to complement other reports in the evaluation series prepared by the Electronic Text Consortium. For this reason, the narration assumes that readers have a working knowledge of terms and principles related to electronic text services. Readers who do not have such familiarity are referred to report number one in our series, Electronic Text and Higher Education. At the same time, the report attempts to provide a simple and practical assessment of economic issues associated with electronic text for college administrators, faculty and planners. In this sense, it offers a layman's guide to equipment costs, staffing, production timetables and cost recovery options for a range of electronic text services. Further, this report is broad in scope, including those electronic text technologies and services that are undergoing tests by the Consortium as well as other viable options that are available to higher education.

The report is based upon several sources of data, including a survey of electronic text managers in the commercial and nonprofit sectors; a survey of college students in three states, dealing with their media habits, access to personal computers and plans to purchase new technologies in the near future; an aggregation of electronic text industry cost and pricing data; and a secondary analysis of survey data collected by other researchers on the uses of new technologies in colleges.

INTRODUCTION

It is premature to attempt to build a comprehensive economic model for electronic text in American higher education. There are too many variables and uncertainties to assess with confidence the cost per student of a large state university videotex service or the investment required for national implementation of educational teletext services. However, it is possible to outline some of the economic components that will eventually contribute to these larger models of electronic text services, e.g. equipment costs and staff requirements for an electronic text center at a university affiliated public television station or a small videotex service within a college history department that serves distant learners. This report analyzes a number of these service components. In turn, a reader can build a model for services in a particular higher education environment by using the data provided here and reworking it in the context of a specific higher education institution.

In this review of service options and marketplace trends, a few key elements will emerge. It may be useful to highlight them here and then return to them for further discussion in the Conclusion.

- Many forms of electronic text are value-added services that piggyback on other services or equipment already in the marketplace. For example, the growth of the personal computer in the consumer marketplace as well as broadly-based campus computing facilities make possible services that would not likely be implemented on a stand-alone basis (i.e. if all equipment and transmission

costs were assigned to the electronic text service).

- The development of electronic text services for higher education should be assessed in a different framework from commercial electronic text services. Commercial teletext and videotex services face many economic problems in the near term. While some educational teletext and videotex services may be successfully placed on the commercial systems, a number of higher education applications are more viable economically if they are developed independent of the commercial systems.

- Some applications of electronic text can provide a complete course (e.g. a videotex correspondence course on Marketing). In these instances, there is a straightforward means of cost recovery: tuition. However, the bulk of electronic text applications complement and are integrated with classroom instruction or a video-based telecourse. The cost of developing and means of pricing these electronic text applications must be justified within the context of use. It is not yet clear which means of cost recovery will be most acceptable.

- Electronic text services vary enormously in size, function and location: from an electronic bulletin board in a personal computer serving 15 students to a comprehensive information and transaction service in a mainframe computer serving thousands of users; from a videotex service located in the storage closet of a political science department to a teletext service broadcast nationally by a major television network. Related to this, the range of costs associated with developing a service varies enormously: from a few hundred dollars for the personal computer bulletin board to an extreme of two hundred million dollars (the cost of developing Britain's national videotex service, Prestel).

- Startup costs are significantly greater than ongoing operations costs. It requires considerable time to train a staff, install and debug equipment and pass along the learning curve towards operational efficiency. There is a need for groups with experience to help others move through this startup phase more quickly.

- There is no simple answer to the question, 'what is the most cost efficient way to deliver electronic text services?' The economics of electronic text are related to existing plant at a college, transmission options in a given location, manufacturer decisions to build or not build particular hardware, and marketplace trends in consumer homes as well as college campuses.

GENERAL TRENDS

A few technological trends are very important to the development of electronic text services. The first of these is the growth of personal computers both on college campuses and in consumer households.

In the 1970s, most electronic text planners assumed that a dedicated terminal would serve teletext and videotex applications. This course of development proved to be correct in relation to teletext, for which decoders can be manufactured and sold for 100 to 300 dollars and the service itself is free. However, with videotex the cost of a dedicated terminal in addition to usage fees restricted the consumer marketplace. Fortunately, personal computers (which can be adapted to serve as a videotex terminal) have begun to enter the marketplace at a very rapid rate. Indeed, the potential for videotex services is tied closely to the growth patterns for personal computers.

In mid 1984, estimates of penetration levels for personal computers in American consumer households ranged between eight and fifteen percent. The wide variation in estimates relates to how one defines a personal computer and what is meant by household use. If very inexpensive personal computers (under $200) are included as well as personal computers used exclusively for a business at home then the high estimate of fifteen percent is reasonable. However, if these very inexpensive and not-so-useful personal computers are excluded and, if further, a household

personal computer is defined as one available for general uses then the lower estimate of eight percent is reasonable. In either case, the growth of personal computers in households has been remarkable, exceeding 100 percent per year for the past five years. While growth is very strong, the personal computer "boom" is not endless or unqualified. In Spring 1984 there was a 20 percent decline in sales of low-end personal computers (under $300), compared to the same period in 1983. Sales of computers in the mid ($400 - $1,500) and upper ($1,500 - $5,000) end of the market continued to be strong.* What this appears to mean is that within a pattern of strong overall growth, the low end personal computer may have had some elements of a fad. The trend remains encouraging for higher education in that surveys conducted by the Electronic Text Consortium as well as national survey groups (A.C. Nielsen) suggest that the college market for personal computers lies in the mid to upper range purchasing patterns ($1,000 - $2,500). Of equal importance for videotex is the percentage of modem equipped personal computers, since a modem is required for a personal computer to communicate over telephone lines. MCI estimates that 15 percent of household personal computers in 1984 are equipped with a modem and, further, they project that 60 percent of household personal computers in 1990 will be equipped with a modem. This projection is not unreasonable in that many mid range personal computers in the period 1985 and beyond will have modems as standard features.

* NY Times, June 4, 1984 p 1.

It is difficult to capture an accurate measure of personal computer penetration and uses among college students and faculty since the market is changing so rapidly. A few indications may be inferred from a survey by the Electronic Text Consortium on three campuses, a survey of the University of Wisconsin faculty by Pat Dickson, and a survey of faculty conducted by CPB and NCES*. Data from these surveys suggest that 15 percent of college students own or have use of a personal computer in their permanent residence. Another 25 to 30 percent have easy access to a personal computer at school, in a library or through friends. Equally important, a majority of those who do not own a personal computer intend to purchase one in the next few years. Most of the computers already purchased as well as those which students plan to purchase fall in a mid price range, $1,000 to $2,500. Also, among those planning to purchase a personal computer, nearly all intend to purchase a modem or are considering the purchase of a modem.

In the University of Wisconsin faculty survey, 25 percent of faculty indicated that they own a personal computer. Another 50 percent plan to purchase a personal computer in the near future (at a median price of $3,500). Further, an estimated 30 percent of University of Wisconsin courses make some use of computers. This latter figure parallels data from the CPB/NCES survey, where one third of the faculty members surveyed encourage or require computer-based tutorials; 20 percent encourage or require interactive communication

* Each of these surveys involved relatively small samples. They should be regarded as suggestive of trends in higher education, not a definitive measurement of the national higher education scene.

with computers; and 45 percent encourage or require word processing by students. Thus, while accurate national measurements of college-based personal computer uses are difficult to capture and highly time sensitive, there are many indications which suggest that penetration of personal computers in families with college students exceeds national averages and the use of personal computers in courses and related activities is quite high. These trends are important for electronic text because they demonstrate that a base of equipment and usage patterns are in place, upon which value added videotex services may be developed.

A second important marketplace trend is the development of technology and software for local area networks (LANs). Local area networks offer the potential to reduce the costs of some videotex services as well as to improve the speed and reliability of service delivery. In simple terms, local area networks link personal computers in a limited spatial environment, often by coaxial cable or fiber optic cable. LANs are short haul networks. In addition to data, they can carry voice and video. The network topology for LANs is often described as star switched, bus or ring depending on the way information is passed or switched among terminals in the network. For videotex development, a significant feature of LANs is the potential to reduce the dependence on time sharing of a minicomputer or mainframe as well as communication over the national packet switching networks while, at the same time, allowing LAN users to interconnect with these other means of data transmission when necessary.

Another way to reduce the costs of an electronic text service is by increasing the intelligence and memory of a user's terminal and downloading packages or files of information, rather than maintaining continuous communication with the host computer. This is a crucial issue in understanding the economic feasibility of electronic text. A trend away from continuous communication with the host computer is apparent in the planning and design of new videotex services such as Trintex*, some electronic home banking services and recent overhauls of earlier videotex services such as Prestel. In earlier services, e.g. The Source, a user has been charged on the basis of connect time. Therefore, it is in the interest of system designers to keep users online as long as possible and therefore keep the meter ticking. However, the cost of such a service for many users is prohibitive and, in the long term, it can create a traffic problem for the system operator. That is, only a limited number of people can be online at a given time and, further, the greater the number of people online at a given point the slower the response time of the system.

Newer systems are designed to send packages or personalized files of desired information to a user. In essence, a user goes online, receives a package of information that he or she has preselected, goes offline to read the information or prepare messages, then goes back online to send messages (electronic mail,

* Trintex is the trade name for the new joint venture of CBS, IBM and Sears Roebuck.

answers to a test, an essay on an assigned topic, a banking transaction, etc.) to the system. This design allows system operators to charge fixed monthly fees for videotex service and to accommodate many more users*.

Teletext can also be used to download packages of information to a user's personal computer. Indeed, teletext offers a very economical means of downloading information to a user. In a major test of teletext downloading for education, in Britain, it was found to be technically robust and cost effective (Mapp et al, 1983).

Another, perhaps less apparent, marketplace trend that may affect the development of videotex is the increased sales of telephones. In 1979, there were 77 telephones for every 100 people in the U.S. (Mitchell 1979). Since then, deregulation has encouraged the sale of many additional telephones, e.g. 19 million telephones were sold in 1983 and an estimated 30 million telephones will be sold in 1984 (Electronic Industry Association 1984). The typical American household now has more than one telephone. The "second" or "third" household telephone increases the likelihood that a videotex terminal can be placed in an acceptable location within a household. While a seemingly minor issue, the placement of household telephones has been one of the inhibiting elements in the growth of the Prestel videotex service in Britain (the vast majority of British homes have one telephone, often placed in an entrance hall).

* CompuServe estimates that a commercial videotex system operator should assume that 1.5 percent of subscribers may be online at a given moment. Thus, 20 ports could accommodate 1,300 users. However, it is likely that an educational videotex service will experience peaks of use, by time of day and points in a semester, when more than 1.5 percent of students seek access to the system simultaneously.

COSTS OF EXISTING SERVICES AND EQUIPMENT

It is important to review a full range of equipment and service costs including older electronic text services, recently introduced electronic text services and associated telecommunication costs that affect the cost of a service for a user. This section will review each of these areas as well as user terminal costs.

Telephone Service

Perhaps the most complex and variable element in a videotex service is the cost of a telephone connection between a user's terminal and the host computer. This may be illustrated with an example. Let us assume that a regional consortium of state universities offers a videotex service for oncampus students and distant learners. The service is housed in a campus mainframe at one of the universities and students are charged a flat fee of $25 per month regardless of usage level. The only cost to a user, in addition to the $25 per month fee, is telephone connect time. Table 1 estimates the total cost of the service for four types of student each of whom uses the service 20 times per month, for 30 minutes per session or a total of 10 hours per month connect time. It is apparent from Table 1 that costs for the service can vary by a factor of 4 among students based upon their location and the telephone rate structure in place.

TABLE 1. Charges For Telephone Service Under Four Conditions

Location of Student & Telephone Rate Structure	Estimated Local Telephone Charges (dollars)	Packet Switching Network Charges (dollars)	Flat Fee Videotex Charge (dollars)	Total Cost Per Month (dollars)
Student A: lives near campus & has flat rate, untimed telephone service	8	-	25	33
Student B: lives 5 miles from campus & has timed message Telephone service	30	-	25	55
Student C: lives 100 miles from campus in another state. Must use local timed message service to reach packet switching network which in turn connects student to campus mainframe.	30	80	25	135
Student D: lives 600 miles from campus that houses videotex service. Uses flat rate local telephone service and packet switching network during evening hours and weekends.	8	60	25	93

In order to interpret Table 1 it is necessary to understand that in some parts of the U.S. local telephone service is untimed and unlimited: a user pays a flat fee nomatter how many local calls are placed or the length of the calls. This type of service is changing rapidly to timed message units that vary according to local zones. However, even under these conditions a user may be able to pay a flat fee (e.g. $8 to $14) for unlimited, untimed calls within a very small geographic zone. Other telephone rate structures

require timed message units, typically four to six cents per minute depending upon the zone.

If a user must connect to a distant computer, he or she will likely use a packet switching network, costing six to ten dollars per hour depending upon time of day. The packet switching network is cheaper, under most circumstances, than long distance telephone charges. However, a user incurs a local telephone call to the packet switching network in addition to the six to ten dollars per hour charge for the packet switching network link to the distant computer.

A number of elements must be assessed in considering the overall telephone charges that are likely to be associated with a college-based videotex service and the acceptability of those charges from a student perspective. For example, where are the student users located during the school year in relation to the host computer for the service? And, do they have easy access to a telephone? One survey of U.S. college students found that during the school year 41 percent live on campus, 28 percent live near the campus, and 31 percent commute (Simmons Market Research, 1984). Of those living on campus, many share telephone service with others or rely on public telephones. However, on campus student housing also offers the strongest opportunity for developing local area networks and/or hard wire connections into a campus mainframe. It is reasonable to assume that commuting college students and distant learners generally live in their permanent household and that these residences share telephone usage characteristics with the general

population. The most recent published assessment of household telephone usage and billing (Mitchell, 1979) indicated that the average residence telephone bill was $280 per year. The average home in the period analyzed made 1,515 calls per year. The vast majority of these were local calls with a mean length of four minutes. Approximately one third of calls occurred after 5 pm, and these were somewhat longer, averaging seven minutes. By 1986-87 it is reasonable to expect that deregulation will have nearly doubled the average phone bill of 1979, to more than $ 500 per year. Even with this higher base, some configurations of videotex might add a 100 percent surcharge to the telephone bill of a family with a student in college. This suggests that alternative configurations of videotex, e.g. downloading, more local intelligence in the user terminal, local area networks and local area data transports (discussed below) will be very important in bringing telephone charges associated with videotex into an acceptable range.

Usage patterns for telephones in households also suggest a few potential problems. With one third of telephone usage after 5 pm and longer calls during the evening, competition may develop for use of the telephone line. Here as well, downloading can ease telephone traffic problems during evening hours when videotex usage is likely to be high.

There is little data available on the telephone usage patterns of students living off campus. While a systematic investigation is needed, it is reasonable to assume that some of these students

share telephone facilities with others (e.g. those living in furnished rooms) or rely principally on public telephones. For such students, oncampus access to videotex (e.g. terminals in the library or study halls) may be necessary.

Along with downloading transmission techniques, the development of Local Area Data Transports (LADTs) will be an important component for economically feasible videotex service. An LADT is an inexpensive local packet switching network. The first LADT was setup in South Florida to support the Knight Ridder-AT&T videotex service, Viewtron. It provides telephone access to the videotex service for one dollar per hour. LADTs are scheduled to be installed in several major metropolitan areas during 1985-86. However, it is not likely that most households will have access to an LADT until the 1990s.

Databases and Existing Videotex Services

There are hundreds of commercial databases in the U.S. Most of these are intended for use by lawyers, business and academic researchers and government groups. Further, most of them are quite expensive, e.g. $50 to $1[illegible] per hour of use.

Videotex, in many ways, represents an attempt to advance database technology, extend the range of services offered, render services more easy to use and attractive, and bring the cost of use within the reach of ordinary citizens. A sample of existing videotex services, along with associated costs, is presented in Table 2.

TABLE 2. A Sample of U.S. Videotex Services

Trade Name	Description	Pricing Structure
The Source (Readers Digest)	A general business & consumer information, entertainment, and electronic mail service with approx. 30,000 subscribers. Available nationally; uses Asci black and white text standard.	Registration fee of $49.95; $10 per month minimum. Usage charge $20.75 per hr during the day, $7.75 per hr evenings & weekends. Access to national packet switching network included in hourly charges. User incurs local telephone charges to reach packet switching network and cost of receiving terminal.
CompuServe (H&R Block)	Same as above, with approx. 165,000 subscribers.	Registration fee of $39.95; no minimum monthly fee. Usage charge $12.50 per hr during the day, $6 per hr evenings and weekends. Access to national packet switching network included in hourly charges. User incurs local telephone charges to reach packet switching network and cost of receiving terminal.
Viewtron (Knight Ridder)	A general business & consumer information, entertainment, banking & electronic mail service with approx. 2,000 subscribers. Available in South Florida; uses more advanced NAPLPS standard.	Recently changed pricing structure. $39.95 per month fee (3 month minimum) includes unlimited use of some services and rental fee for receiving terminal. Other services, e.g. electronic mail and stock information, incur surcharges on a per use basis or per month fee. Telephone access is via LADT at a cost of $1 per hour.
Gateway (Times Mirror)	Same as Viewtron. Service scheduled to begin Fall 1984 in California.	Basic subscriber fee of $29.95 per month includes rental of receiving terminal and up to 20 hours use of selected services. Surcharges for value added services and usage over 20 hours. Telephone access is via LADT at a cost of $1 per hour.

There are some educational services within each of these videotex systems, e.g. the University of Wisconsin-Extension as part its work within the Electronic Text Consortium has placed materials on CompuServe that accompany the Annenberg/CPB sponsored telecourse Congress: We The People. And, the electronic text course created by the University of Nebraska-Lincoln will be carried on Keycom, a new videotex service that uses the NAPLPS standard. Moreover, educational videotex services have been popular in commercial videotex trials (Carey 1984).

The financial arrangements between a creator of electronic text materials and a commercial videotex system operator vary considerably. In some instances, the relationship is similar to author and publisher, i.e. the creator of materials sells them to a system operator for a flat fee or a fee plus royalty payments based upon usage. In a second arrangement, an educational group sets up a private user group on the commercial videotex service and pays the system operator for "space" on the system. In other instances, a barter relationship develops in which the system operator may provide equipment and use of the service in exchange for general use of content created by the educational group.

Table 3 outlines the charges set by the Source for establishing a closed user group within their system. These fees apply to educational closed user groups as well as corporate groups.

TABLE 3. Fees For A Closed User Group On The Source

- 5K flat fee to establish a closed user group. This is an administrative charge as well as a fee for software to support the closed user group.
- 25 member minimum for the closed user group. Each user pays standard usage fees (see Table 2).
- Storage of files within the Source are charged on a sliding scale: 1-10 files @ 50¢ per file, per month; 11-99 files @ 20¢ per file per month. Each file contains approximately 2K of [illegible]

Electronic Mail Services

Each of the commercial videotex services described above may be used to send electronic mail to other subscribers of the same service. In the case of CompuServe and the Source, a user pays standard hourly fees: the time required to type the message or memo into the system. In addition, a receiver of messages pays hourly fees to print out the information or read it from a CRT. In the case of services with fixed monthly fees, there is a surcharge to send electronic mail, typically 10-25¢ per message. Other videotex services with fixed fees for predetermined content (e.g. Telelearning) may charge communication fees for individual messages sent and received by users beyond a preset threshhold.

In addition, there are many services that provide electronic mail (E-mail) exclusively or in conjunction with a more limited range of information services. A few of these services are outlined in Table 4, along with the pricing structure for each.

TABLE 4. Selected Electronic Mail Services

Service	Fees
Western Union Easy Link	30¢ per minute for input of information at 300 baud. 45¢ for input at 1200 baud.
ITT Dialcom	16 - 34¢ per minute for input, based upon time of day.
MCI Mail	$1 flat fee for three to five page document.

Note: In addition, a user incurs a telephone charge to reach the electronic mail carrier and, in most instances, a fee to retrieve electronic mail.

Many university computing facilities have electronic mail services. Fees for these electronic mail services vary. In some instances, the cost of electronic mail is built into a general department usage fee. In other instances, electronic mail costs represent an aggregate of two separate fees, for storage and online time. In a typical service, this aggregate fee is two to ten dollars per hour of usage, based upon time of day.

Computer Conferencing

In simple terms, computer conferencing is an electronic mail service with open and closed group files in addition to person to person messaging. That is, individuals can send private messages to other individuals. In addition, some files are established on general topics (e.g. Campus Suggestion Box). Here, any user can make entries and all users can read the list of entries. Computer

conferencing services can also provide closed user group files. Here, a restricted group of users (e.g. students in Chemistry 101) can make entries and read the list of entries.

One of the most sophisticated computer conferencing services has been established at the New Jersey Institute of Technology. The service, EIES or the electronic information and exchange service, is open to use by a wide range of researchers, students and private individuals. The fee structure for EIES is described in Table 5.

TABLE 5. Fee Structure for EIES Computer Conferencing Service

Individuals	
CLASS ONE (unlimited usage)	$75 per month plus connect charges
CLASS TWO (hourly use charges)	$8 per hr of usage ($25 monthly minimum) plus connect charges
Group	
GROUP FEE	$200 per month (includes 1 Class One account for instructor)
GROUP MEMBER FEES	$10 per month account fee per member plus $8 per hour of use and connect charges

Note: Connect charges for a user near the NJ Institute of technology would be the cost of a local telephone call. Others would incur a local telephone call to a packet switching network plus $6 to $10 per hour for the packet switching network depending upon time of day.

The fee structure in Table 5 may be used to compute the cost of a closed user group seminar. Let us assume that 15 distant learners and their instructor spend two hours per week on EIES over a 13

week period. The seminar members are scattered throughout a distant state but they restrict their use of EIES to evening hours in order to control communication costs. Table 6 outlines the costs associated with this electronic text seminar.

TABLE 6. Cost Scenario For An Electronic Text Seminar

Cost Category	Rate	Total
Administrative Fee (includes account for Instructor)	200 mo x 3	$ 600
Instructor Connect Time	13wks x 2 hrs per week x $6 per hr	156
	Instr/Admin costs to provide the seminar:	$ 756
(Cost Per Student)		
Account Fee	$10 mo x 3 months	$ 30
System Usage	13wks x 2 hrs per week x $8 per hr	208
Connect Time	13wks x 2 hrs per week x $6 per hr	156
	Total Cost Per Student For Communication:	$ 394

Note: In addition, each student would incur a local telephone charge to reach the packet switching network.

Each college or university with a minicomputer or mainframe can install a computer conferencing service. The cost of software and installation for such a service is approximately 35K. While these off-the-shelf software packages are less sophisticated than

EIES, they can easily accommodate the electronic text seminar described above. When installed in the local campus computing facilities, the cost per student for usage would be approximately $2 to $10 per hour (depending upon time of day) plus the cost of telephone charges to reach the campus computing facility.

Broadcast Teletext

In most applications, broadcast teletext services are free. There are no transmission costs since the teletext signal piggybacks on the regular broadcast TV signal. However, there are equipment and operations costs for the service provider and decoder costs for users. These are discussed in subsequent sections of this report.

Typically, a commercial teletext operator recovers costs through advertising. Cost recovery for educational teletext through tuition fees or other direct charges to students has not yet been tested in the U.S.

Local Area Networks

Local area networks are a promising transmission scheme for sending electronic text among many personal computers on a campus or in a limited geographic area. Some local area network hardware and software are available in 1984 and many are to be introduced in 1985. The costs associated with a local area network include: a/ a host or controlling computer, often a specially equipped personal computer; b/ a personal computer for each location in the network; c/ coaxial or fiber optic cable linking each node in

the network; and, d/ communication software for each personal computer in the network as well as the host or controlling computer. Some of the costs associated with a local area network are difficult to estimate since they will vary in relation to each specific location, e.g. installing the coaxial cable in campus buildings. Other costs are variable but will not necessarily be assigned to the local area network, e.g. the cost of hardware for each personal computer that joins the network (these personal computers will likely be used for many purposes). The local area network does require adaptation for the computer that is to serve as the host as well as for each personal computer using the network. The costs of local area networks for IBM personal computers vary between $1,000 - $2,500 for adapting the host personal computer, and between $500 - $850 to adapt each personal computer in the network. Thus, a student library complex with 20 existing IBM personal computers could be transformed into a local area network for $11,000 to $19,500 plus the cost of installing the coaxial cable that links each terminal.

User Terminals For Teletext and Videotex

User terminals for electronic text may be divided into two broad categories, those for broadcast teletext reception and those for receiving videotex. Costs for broadcast teletext are simpler to describe and will be discussed first.

Teletext terminals. In order to receive broadcast teletext, a user requires a TV set with a special teletext decoder. Currently, there

are two competing teletext systems in the U.S., World System Teletext (WST) and North American Broadcast Teletext Standard (NABTS). Both are available in limited quantities in 1984. Therefore, it is difficult to provide accurate price figures for decoders once they are manufactured in large quantities. A reasonable estimate is that a TV set equipped with World System Teletext will cost approximately $100 over the normal cost of the same set, whereas a TV set equipped with NABTS will cost approximately $200 over the normal cost of the same set.

In some planned applications for teletext, data will be downloaded via the broadcast teletext signal and stored in a personal computer. This is an inexpensive way to transmit large volumes of electronic text to a virtually unlimited number of users. In order to receive and store downloaded teletext, a user requires a decoder equipped TV, as described above, plus a personal computer with moderate storage capacity.

Videotex terminals. There are many options for videotex terminals: stand-alone terminal or adapted personal computer; ASCI, NAPLPS or Prestel standard; cheap or expensive. These options are related to the service a user wishes to receive as well as other intended uses for the terminal. Table 7 outlines some of these options along with pricing and commentary on uses for each.

TABLE ?. Videotex Terminal Categories and Pricing

Terminal Category	Sample Equipment Package	Price	Comment
ASCI: Low-end personal computer	Commodore 64	190	Can receive many ASCI videotex services, e.g. CompuServe and the Source, as well as serve as stand-alone personal computer.
	Datasette	60	
	Modem & Software	60	
		$ 310	
NAPLPS: Low-end adapted personal computer	Commodore 64	190	Can receive ASCI videotex services as well as many NAPLPS services, and serve as stand-alone personal computer.
	Datasette	60	
	Modem	60	
	NAPLPS Software	100	
		$ 410	
NAPLPS: Stand-alone terminal	Sceptre Terminal	$ 600*	Can receive Viewtron, Gateway and other NAPLPS videotex services, but can't be used as personal computer
NAPLPS: Mid-range adapted personal computer	IBM PC	2,200	Can receive ASCI videotex services as well as many NAPLPS services, and serve as stand-alone personal computer.
	Modem	450	
	NAPLPS Board	250	
		$ 2,900	
PRESTEL: Mid-range adapted personal computer	Apple IIe with disc drive	1,200	Can receive ASCI videotex services as well as Prestel standard videotex, and serve as stand-alone personal computer.
	Modem	200	
	Prestel Software	85	
		$ 1,485	

* Introductory price. Price may rise to $900 in the near future.

Hardware And Software To Create Electronic Text

It is reasonable to group electronic text into three categories: 1/ simple ASCI text; 2/ World System - Prestel; and, 3/ NAPLPS - NABTS. Any personal computer that can communicate with an ASCI-based videotex service can also serve as an ASCI frame

creation terminal. In this sense, the $310 Commodore 64 package in Table 7 can serve as an ASCI frame creation terminal. However, in creating text for CompuServe or the Source, the user terminal would draw upon some of the considerable software support that resides in the host computer of CompuServe or the Source.

A World System frame creation terminal costs approximately $3,500. In addition, an Apple personal computer with a special software card can serve as a frame creation terminal for Prestel videotex. The cost of such an adapted personal computer package is approximately $ 1,500. More sophisticated frame creation terminals for World System Teletext and Prestel videotex range between $5,000 and $15,000.

Frame creation terminals for NAPLPS and NABTS vary across a broad cost range. Table 8 outlines some frame creation options for NAPLPS videotex. Two of the options in Table 8, the AT&T and Norpak terminals, may also be used to create NABTS teletext. However, to serve this function they require a modified software package.

TABLE 8. NAPLPS Frame Creation Terminals & Software Packages

Terminal or Software Package	Approximate Retail Price
AT&T Frame Creation Terminal with software	$ 40,000
Norpak IPS-2 Terminal with software	27,000
Cableshare Picture Painter Hardware & Software Package (This package adapts an IBM PC or DEC PC to serve as frame creation terminal)	5,000

There are many additional terminals and software packages to support NAPLPS frame creation. Some software packages, which run on mid range personal computers, cost under $2,000. However, a group pursuing these options should be aware of many kinks and bugs in some software packages, such that they permit frame creation for NAPLPS videotex service A but not NAPLPS videotex service B. These important but technical issues are beyond the scope of this report. They will be addressed in subsequent reports of the Electronic Text Consortium.

A frame creation terminal is one component of an electronic text production capability. Other necessary components along with general production options for higher education groups are discussed in the next section of this report.

EQUIPMENT, STAFF AND SERVICE MODELS FOR COLLEGES

From a college administrator's point of view, a few practical questions are likely to arise at this point. These questions include: what options are most realistic for my college; what will it cost; and, will electronic text be an effective and useful tool for higher education? Effectiveness and general utility are not addressed in this report. However, it is possible to address the other questions. To do this, it is useful to review very briefly some points covered earlier in this report and in other reports of the Electronic Text Consortium, then to move on to cost and production models for colleges.

Service Options

While service options were described more fully in an earlier report*, it may be helpful to list the major service options here, first, from a transmission perspective, then, from an educational usage perspective. From a transmission perspective, major options for a college or higher education service provider include:

- Create a teletext service on a local public television station, cable channel, low power TV station or a campus closed circuit TV system.
- Receive and retransmit a national teletext feed.
- Create a videotex service on a campus mainframe computer, minicomputer, local area network or high-end microcomputer.
- Use a national videotex service as a host for educational materials created by a local college or other higher education group.

* Philip Rubin, A Primer on Electronic Text Technology For College Administrators. San Diego: The Electronic Text Consortium, Report Number Four, 1984.

- Create electronic text on diskettes, to be used by students on their personal computer or to accompany a videodisc.

- Download electronic text via broadcast teletext or videotex for storage in a student's personal computer.

Among the major educational uses for electronic text are:

- Stand-alone courses.

- Supplements to classroom instruction.

- Supplements to video instruction, including broadcast telecourses, videocassettes and videodiscs.

- Electronic mail among students, instructors and the administrative departments of a college.

- Information about campus activities or to assist with special events such as course registration.

- Simulations, educational games and other interactive exercises for coursework or study skill development.

- Use of electronic text for conferencing or seminars on course-related topics.

- More "friendly" design for traditional database applications, e.g. a library card catalogue.

Cost Categories

In developing one or more of the services outlined above, the following general cost categories should be addressed:

- Staff to create the service.
- Staff training.
- Equipment
- Software purchase or licensing fees.
- Maintenance of hardware
- Maintenance of software
- Transmission
- Overhead, office and/or studio space, and other administrative costs.

Not all services have costs in each of these categories. Further, some cost categories, notably overhead and office space, will vary a great deal from one institution to another. However, most readers will be able to estimate these costs based upon their decisions about staff, equipment and other categories that are analyzed in this section. One hidden cost, and potential barrier, is the interface between an electronic text service and existing plant at a college or broadcast facility. For example, if a videotex service must go through an existing and outdated campus telephone system or if a teletext service must utilize a poorly maintained broadcast transmitter, technical problems (and associated costs) may follow.

Equipment Costs

In some instances, there are no capital equipment costs for an electronic text producing agency. For example, some services can utilize existing personal computers and other campus computing facilities to create electronic text. This is particularly relevant for services that involve simple Asci text display on a national videotex service or files in a campus mainframe. However, there are equipment costs associated with most teletext and videotex services, particularly those which utilize one of the standards with advanced graphics, e.g. NABTS and NAPLPS. Table 9 outlines a broad range of services along with estimates of equipment costs associated with each.

TABLE 9. Equipment Cost Estimates For Electronic Text Services

Level Of Service	Range Of Equipment Costs	Equipment Components
National Teletext	250K - 1 Million	Several frame creation terminals; large mini-computer to manage files; extensive support equipment.
Local Origination Teletext	50K - 250K	1-4 frame creation terminals; mini computer to manage files; VBI inserter and moderate support equipment.
Local Teletext Insertion	8K - 15K	Databridge to insert teletext feed from a national service.
Open Channel Cabletext	15K - 60K	2-3 personal computers to create text; software package to manage files; hard disc; graphics generator; channel modulator; moderate support equipment.
National Videotex Service	10 - 100 Million	Complex array of mainframe and minicomputers; 10-25 frame creation terminals; extensive software development; extensive support equipment.
Campus-Based or Regional Videotex	25K - 250K	1-5 frame creation terminals; supermicro or minicomputer to manage files; 5 to 50 ports for communications; moderate support equipment.
Campus-Based Videotex Frame Creation Center (to supply a national or regional videotex service operator)	12K - 75K	1 or more personal computers with special software packages, or frame creation terminals; modem(s); moderate support equipment.

There is much variability in the range of costs described in Table 9, both within a given service category and across services. The major reasons for the variability are: the number of frame creation terminals or means to create electronic text; the storage and processing capacity of the service; and, the numbers of users to be served. In addition, there is an important and variable cost not highlighted in Table 9 - software. The issues associated with software costs include, 1/ can it be purchased or must it be leased, at what cost; 2/ what costs are associated with adapting and installing the software for a specific application; and, 3/ what costs are associated with maintaining the software?

In some cases, a suitable off-the-shelf software package may not exist. Costs associated with creating original software will vary in relation to the size and complexity. For simple or moderate level applications, software expertise may exist on a campus. However, software development for a vary large service (e.g. a national videotex service) can cost several million dollars.

Much of the equipment to serve the electronic text services described in Table 9 can be used for more than one application. This is particularly relevant to frame creation terminals. The shared use of equipment for more than one application (e.g. frames for a campus videotex service and frames for a national videotex system) can reduce the costs assigned to each service.

Staffing and Production Time

In some instances, e.g. electronic text in support of a specific oncampus course, frames of information may be created by

the individual faculty member or students. In these cases, frame creation can be treated as a job-associated task, much as individual faculty members prepare class notes or audio visual materials for their classes. However, many electronic text services require a staff to produce the service or set of materials. For such applications, questions about staff size, training needs and production time arise*. Our survey of electronic text managers addressed the staffing for a local teletext service on a university-affiliated public television station. A summary of the responses is presented in Table 10.

TABLE 10. Summary of Responses on Staffing For a Local Teletext Service.

Category	Number	Full or Part Time
Manager	1	Full
Chief Editor	1	Full
Graphic Artists	2	Full
Writer-editor	3	Full
Secretary	1	Full
Engineering Support	1	Pt Time
Computer Programmer	1	Pt Time

Table 10 outlines the suggested staffing for a full scale local teletext service with 100 frames of general information, community information and educational content - most of which is updated daily or more than once a day. Responses to this question

* This discussion draws upon two sources: a survey of twelve electronic text managers in the commercial and nonprofit sectors: and research undertaken by Nugent et al (1983) at the University of Nebraska.

were relatively consistent. However, some respondents indicated that they would use more part time personnel and spread the work across more than one shift in the broadcast day.

Our respondents were also asked to staff a hypothetical videotex project. The project was mandated to create videotex packages that would supplement a major public television series and render it more useful for higher education instruction. The videotex packages were to be created for a national service using the NAPLPS standard. Production requirements in the scenario included the creation of a 200 frame videotex package for each of 13 one hour broadcast programs, or, 2600 frames of text and graphics. A summary of the responses for staffing this hypothetical project is presented in Table 11.

TABLE 11. Summary of Responses on Staffing a Project to Create 13 Videotex Packages (200 Frames Each)

Category	Number	Months Of Work	Full or Part Time
Manager	1	6	Full
Chief Editor	1	6	Full
Graphic Artist	2	6	Full
Writer-editor	2	6	Full
Researcher	1	6	Full
Secretary	1	6	Full
Computer Programmer	1	6	Pt Time

There was consistency in the responses about the suggested length for the project. However, respondents differed a good deal

in how they would integrate the functions - writing, research, editing and proofreading. Some would assign all these functions to one staff category while others split the functions, e.g. distinguishing research from writing. Also, respondents noted that the staff requirements and overall length of the project would vary in relation to graphic requirements, the complexity of branching and the type of instruction offered, e.g. simulations, tutorials or reading lists.

Requirements for staff training vary in relation to the complexity of the system, writing vs. graphic frame creation, documentation available for a system and experience of those conducting the training, and the experience as well as skill a new employee brings to the situation. In our survey, respondents indicated that training time for a new writer-editor on a system with good documentation and trainers would require between 3 days and 1 month. At the low end of the time scale is a situation with a relatively uncomplicated electronic text system and a fast learner who brings some previous experience to the project. At the high end of the training time scale is a situation with a complex system and a slow learner who brings no previous experience to the project. Respondents indicated that the training time for a graphic artist under the conditions described above would range between one week and two months. At the low end of training time is their estimate for an experienced print artist and fast learner on a relatively easy electronic text system, while the high end of training time involved their estimate for an

experienced print artist (but slow learner) on a relatively complex system.

Our survey indicated that a new electronic text group, just getting started on a system with poor documentation and little available training, can encounter significant delays. Under these circumstances, a small local videotex service may require 3 to 6 months to setup.

A related production issue with important cost implications is the time required to create individual frames. Owen Nugent et el (1983) investigated this issue in relation to the Nebraska electronic text group's frame creation for INDAX, an alpha-mosaic cabletext service. Nugent distinguishes three categories of frames: all text; text and graphics, in which the graphics fill less than 50 percent of the frame; and, text and graphics, in which graphics fill more than 50 percent of the frame. Further, the Nebraska research distinguishes graphic design and actual frame creation. Table 12 presents the time estimates to create frames in their project.

TABLE 12. Time Estimates For Frame Creation

Function	Est. Time Per Frame
Graphic Design	
Graphics Occupy 50% or more of frame	4 hours
Graphics Occupy less than 50% of frame	45 minutes
Frame Creation	
Graphics Occupy 50% or more of frame	45 minutes
Graphics Occupy less than 50% of frame	20 minutes
Text Only	8 minutes

Source: University of Nebraska-Lincoln

In addition to the time estimates above, Nugent et al state that some additional time is required for subsequent corrections or changes. Further, these estimates do not include other work associated with design time, e.g. flowchart development.

Pricing and Cost Recovery

The economic complexities associated with equipment and production costs are compounded by the potential ways an institution might charge students for these services or allocate costs to existing categories in a college budget. The pricing or cost allocation for these services in turn is likely to have an impact upon their acceptance by students, faculty and administrators.

In simple terms, students currently pay (directly) for courses, textbooks, lab fees and administrative or general fees. They also

pay for housing, food, transportation and other support services necessary for them to earn a degree. However, other costs for a college, e.g. faculty salaries, plant and in most instances audio-visual materials must be recovered indirectly through tuition, general fees or outside funding sources. If this simple model of costs and pricing is applied to electronic text, it appears reasonable to expect students to pay directly, through tuition, for a stand-alone electronic text course. In addition, students can be asked to pay for online communication time, personal computer terminals and electronic text materials on diskettes since these are analogous to educational costs they now assume, i.e. textbooks, transportation to sources of education, and calculators or other personal equipment necessary to do college level work. This is not to argue that students will accept these costs if they are beyond an as yet undetermined threshold, but merely that it is not unreasonable to treat these items as the direct cost-responsibility of students.

More uncertain are pricing options for packages of electronic text that are part of a course and therefore analogous to the audio-visual materials an instructor uses in a course. Here, students may expect costs to be assigned indirectly through tuition fees. Alternatively, the electronic text materials might carry a lab fee or similar surcharge added to tuition. This issue of pricing and cost recovery is very important. Further, it is not likely to be resolved until a body of electronic text materials are offered to students with associated charges attached to them.

CONCLUSION

This assessment of economic issues associated with electronic text has demonstrated that there is extraordinary cost variability among these services. At the extreme upper end is a national videotex service developed from ground zero and intended to serve hundreds of thousands of students. Such a service might cost 20 to 40 million dollars in development alone. Such large scale services do not appear to be appropriate for higher education at a local, state, regional or even national level. At the low end, individual faculty members can create simple electronic text packages on their own personal computers and distribute them on diskettes to students who can use them on their own personal computers or computing facilities on a campus. These latter applications, which piggyback on existing facilities, are very reasonable in cost.

In between these two examples are the bulk of electronic text services which are economically viable if developed with careful planning and a critical understanding of the higher education environment where they must find acceptance. In attempting to bring costs and pricing within acceptable parameters, a few marketplace trends and approaches to product development are important to stress.

First, the growth of the personal computer among college students and faculty is very important. This permits the development of electronic text as a value added service at

relatively low costs for students. In the period 1985-88, a student with a mid range personal computer ($1,000 to $2,500) will be able to purchase a modem and software package that are necessary to receive many of the advanced electronic text services for $300 to $500. Beyond, 1988, mid range personal computers will likely have built-in modems and the cost of software to receive NAPLPS will probably drop to $100. Further, the growth of local area data transports (LADTs) in the period 1985-1990 will allow relatively low cost data communication over telephone lines, i.e. $1 per hour.

Second, local electronic text services are becoming very important for low cost higher education applications. The specific transmission method for these local services is likely to vary from one area to another and may include local teletext, local videotex housed in a campus mainframe or department minicomputer, and forms of local area networks. This is not to argue that the placement of higher education materials on some national videotex services is not viable. However, higher education should not depend principally upon the current generation of national videotex services. By 1990, a new generation of national videotex services, which relies heavily upon downloading technology, may bring the costs of service provision within a more acceptable range.

Third, the high costs associated with sophisticated graphics (the University of Nebraska team within the Electronic Text Consortium estimates that an all-graphics sequence requires nine times the production and development work of a sequence with text alone) necessitates that the use of graphics be planned carefully.

This is not to argue against the use of graphics. Graphics are both attractive to students and crucial in some content areas. However, the type and amount of graphics in a service must be managed with a keen eye on costs.

Fourth, significant costs are associated with the development of an electronic text system and staff. Cost-efficiencies emerge over time as staff gain experience, the system is debugged and ways are found to obtain multiple uses of products. Some assistance may be needed from experienced electronic text groups to help others move through the early learning curve.

Finally, the long term economic viability of electronic text will be affected by broad productivity needs in higher education. Data from the U.S. Census Bureau suggests that the number of college age students will decline after 1987 and continue a downward trend until the late 1990s. With declining enrollments, colleges will be pressured to increase their productivity oncampus and extend their reach to more distant learners and continuing adult learners. If electronic text can demonstrate its strength as a tool of productivity and extended reach, it will increase its chances for broad acceptance in higher education.

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